

Early Contributions to the Johns Hopkins Hospital by the “Other” Surgeon: John Shaw Billings

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Dr. William Stewart Halsted, the first chief of surgery at the Johns Hopkins Hospital, made many contributions to the field of surgery and played a major role in the early success of the Johns Hopkins Hospital. Many consider him to have been the most innovative and influential surgeon that this country has produced. Among his many contributions are the introduction of local and regional anesthesia; the development of the intestinal suture; an operation for advanced breast cancer, an operation for the cure of inguinal hernia, and the first successful resection of a periampullary tumor; and many contributions to thyroid and parathyroid surgery, vascular surgery, and orthopedic surgery. However, his two most important contributions were the introduction of the philosophy of safe surgery and a system for training surgical residents in this country.^{1,2}

However, there was another surgeon who perhaps made even more basic contributions to the early success of the Johns Hopkins Hospital and Medical School and to the field of medicine at large. This individual actually planned the Johns Hopkins Hospital and oversaw its construction, which took 11 years, played an important role in integrating teaching and research into the hospital structure and function, helped recruit its early faculty/staff members, and made important contributions to the Johns Hopkins School of Medicine. In addition to his contributions to Hopkins, he made major pioneering and lasting contributions to the collection, storage, and retrieval of biomedical information. This individual was a member of the American Surgical Association and perhaps one of its most productive and brilliant members. However, even in those cities where he spent most of his career, Washington DC, Baltimore, Philadelphia, New York, and to a lesser extent Boston, he

remains relatively unknown. In reviewing his life and his career, there are many lessons to be learned from the incredibly productive and successful career of Dr. John Shaw Billings.^{3–5}

EARLY LIFE

John Shaw Billings was born in Switzerland County in rural southern Indiana on April 12, 1838. During his early years his father was a shopkeeper and at times a farmer. The family briefly moved east to New York, then to Rhode Island, but subsequently moved back to Indiana when Billings was 10 years old. As a young boy he loved books, preferring them to the companionship of other boys. By age 8 he had already read the Bible, *Robinson Crusoe*, *The Deerslayer*, *The Pathfinder*, and John Bunyan's *Pilgrim's Progress*. A Presbyterian minister, John Clinton Bonham, was probably the first to stimulate young Billings' interest in education. Bonham tutored Billings in Latin and Greek and steered him toward his alma mater, Miami University in Oxford, Ohio. It was perhaps Bonham that introduced the concept to Billings that a baccalaureate degree in the liberal arts and sciences was an excellent background for a professional career. This was an important concept for a young lad who eventually would become a doctor because at that time the vast majority of physicians in this country did not attend college before entering medical school. Most medical schools in the United States at that time, even prestigious ones such as Harvard, were reluctant to require a rigorous academic background because they were afraid that would limit the size of the class. School revenue and faculty salaries depended on the fees collected, and that of course was determined by the size of the class.

When Billings entered Miami University in August 1852, tuition was only \$10. However, that was a large sum for a poor family such as the Billings family, and it is quite remarkable that they were willing and able to provide the support. Billings thrived academically during his 5 years at Miami. For the time his education was remarkably liberal. It

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included the classics as well as a good deal of the natural sciences and mathematics. As a sophomore Billings was first in his class, with a 99.8 average. At graduation he was second in his class of 25.

What stimulated Billings' interest in medicine is unclear. But after working for a year after graduation from college to earn money, he registered in September 1858 at the Medical College of Ohio in Cincinnati. He apparently chose this school because of its proximity to Oxford, Ohio, where his parents had moved during his college years.

This school proved to be an excellent choice. It was founded in 1818 by Dr. Daniel Drake, at the time one of the most outstanding and progressive medical educators in the country.³ Although Drake's influence on the school was strong, his relationship was stormy and on at least two occasions he was dismissed from the faculty because of personality conflicts and disagreements. However, through his efforts a municipal hospital, the Commercial Hospital and Lunatic Asylum, was constructed for teaching at the medical school, as well as for patient care. Drake, who died in 1852, 6 years before Billings entered the school, left a rich legacy. Drake had spent time at the University of Pennsylvania during the era of Dr. Benjamin Rush, who had obtained his medical education at the University of Edinburgh. The Edinburgh influence of a liberal arts background before medical school and emphasis on medical teaching at the bedside were characteristics that Drake readily accepted and brought to the medical school in Cincinnati. After combining with other schools, the Medical College of Ohio eventually became part of the College of Medicine of the University of Cincinnati.

The Medical College of Ohio's curriculum was 2 years. To graduate one had to attend a series of identical lectures for 2 successive years and write a graduation thesis. His preceptor, who was to greatly influence Billings, was Dr. George Curtis Blackman. Blackman had a superb medical library to which he introduced Billings. Billings picked as his topic "The Surgical Treatment of Epilepsy." While writing this thesis, Billings found it difficult to search the literature. At that time there were no common guides to the medical literature, and one had to visit each library personally, many of them private such as Blackman's, and page through books trying to find pertinent information. Billings had other people search libraries in different cities but came to the realization that it was virtually impossible to do a thorough search on any topic in the medical literature at that time. After graduation he served for a year as a resident physician in the Commercial Hospital and Lunatic Asylum, subsequently the Cincinnati General Hospital, and now the Hospital of the University of Cincinnati's College of Medicine.

CIVIL WAR EXPERIENCE

After the outbreak of the Civil War, Billings decided to join the Army in late 1861. He volunteered and was com-

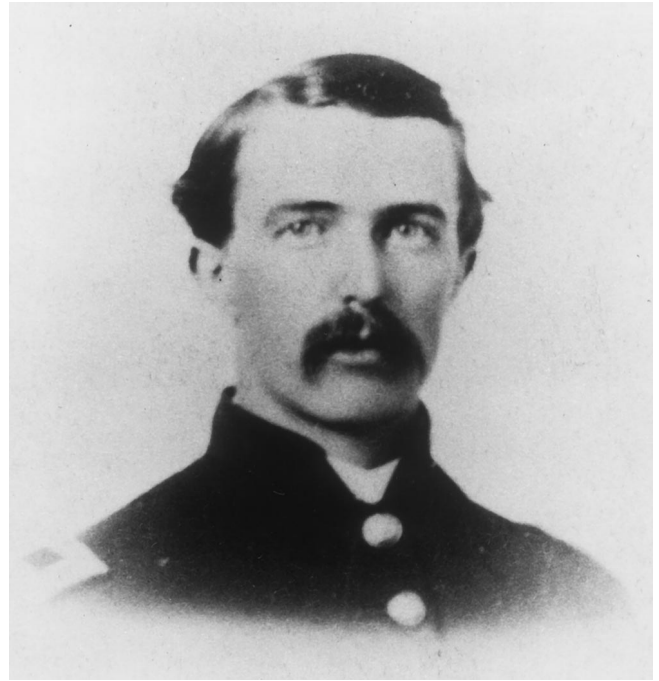


Figure 1. John Shaw Billings at age 23, probably after receiving his commission as a first lieutenant in 1862. (Reproduced with permission of the Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions.)

missioned in early 1862 (Fig. 1). His first assignments were in military hospitals in Washington DC. Even though he had no specific surgical experience, he was commissioned as an assistant surgeon. While serving at the Clifflurne Hospital in Georgetown, an article appeared in *The New York Times* concerning the war effort that included the following sentence: "Surgeon Billings this afternoon performed on one of the Ohio wounded a very delicate and dangerous operation in a manner which elicited the commendation of all who witnessed it."³

In September 1862 Billings married Katherine Mary Stevens, the daughter of a Congressman and Washington lawyer, whom he met during his early months in Washington. They were married at St. John's Church in Georgetown. After his wedding Billings participated actively as a surgeon in at least three major battles, including Chancellorsville and the battle of Gettysburg in July 1863. During the war he was a very active surgeon. In a July 6 letter to his wife during the battle of Gettysburg, Billings wrote: "I am utterly exhausted mentally and physically, have been operating night and day and am still hard at work."³ In a July 9 letter he wrote: "I am covered with blood and am tired out almost completely - - - I have been operating all day long - - -".³ Near the end of the Civil War Billings was assigned to the Medical Director's Office of the Army of the Potomac to help collect data concerning the operations of the Medical Department of the Army. He was given the title of Medical Statistician of the Army of the Potomac. He spent the rest of the war in this capacity. At the end of 1864 he was assigned

to the Office of the Surgeon General, and he was to remain in that office until he retired from the Army some 31 years later in 1895.

After the war Billings had among his many responsibilities two main areas of focus that would occupy a great deal of his time and bring him much attention and acclaim. First, he was given the assignment of enhancing and expanding the library of the Surgeon General's Office, a project that eventually led to the development of the National Library of Medicine, the largest and most complete library of medicine in the world. The second major area of focus had to do with hospitals. At the end of the war Billings was placed in charge of helping to dismantle the many military hospitals that had been built during the war years, a large and instructive task that taught Billings how field hospitals were planned and constructed. In addition, in 1869 he was assigned to visit and inspect all of the Marine hospitals in the United States and report on their general condition.^{6,7} There was widespread dissatisfaction with these 27 hospitals located in major ports throughout the United States. As a result of these two assignments, Billings became one of the leading experts on hospitals and hospital construction in the United States.

LIBRARY OF THE OFFICE OF THE SURGEON GENERAL

The Library of the Office of the Surgeon General was established sometime in the late 18th century to provide books for surgeons working in the field.³ Military surgeons did not have easy access to libraries, and thus it was crucial to supply them with basic reference materials. Billings was assigned to purchase acquisitions for the library. In 1867 he was assigned full time to the library and functioned as its director. In a letter written in 1867 Billings said: "I wish in time to make the library of this office as complete as possible and especially to obtain everything that is new and valuable in the medical book line as soon as it appears."³ That passage, written on Oct. 17, 1867, reveals his objectives for building a comprehensive collection of the medical literature. Ultimately this small library of the Surgeon General's Office grew into the largest and most complete library of bioscientific literature in the world. This accomplishment was brought about almost entirely by Billings' vision, energy, and determination. In these efforts he was mentored and supported by Surgeon General Joseph K. Barnes, who served admirably in that position from 1864 to 1882.

By the late 1870s it was clear that Billings' efforts to enhance the library were successful. He was well on his way to developing one of the largest libraries of medical and bioscientific literature in the world, including the periodical literature. By 1870 Billings had begun to understand the importance of what was being published in journals and began ordering journals for the library. Initially the Library of the Surgeon General's Office was housed in the old Ford's Theater in Washington DC, where Abraham Lincoln

was assassinated on April 14, 1865. Thereafter the theater did not succeed financially because of the public's reluctance to attend performances at the theater where the President had been assassinated. The Surgeon General's quarters on Pennsylvania Avenue and 15th Street were cramped, so in 1867, after the theater was sold to the government and remodeled, the Surgeon General's Office was relocated there. By 1873, just 6 years after he was assigned full time to the library, it had grown from 1,800 volumes to more than 25,000. The library was housed in the old Ford's Theater until the late 1880s, by which time Ford's Theater had become much too small and unsafe. A new library was built on Seventh Street and Independence Avenue, SW, which was completed in 1888. By the time Billings retired from the Army in 1895, the library had grown to nearly 90,000 volumes. The library eventually became known as the Army Medical Library, then the Armed Forces Medical Library, and finally in 1956 as the National Library of Medicine. It is now housed in a beautiful facility outside Washington DC in Bethesda, Maryland (Fig. 2).

At least as important as building the collection of the Surgeon General's Library was the creation of its index. It is not entirely clear when Billings first came on the idea of creating an index that would be so complete that physicians wishing to research a topic could easily do so. In 1876 he wrote a letter to Dr. Samuel D. Gross stating, "a collection of sufficient extent and completeness to meet the wants of the physicians of the United States, an attempt is being made to prepare a catalog and index . . . whose practical usefulness shall not be confined to this country . . ."³ This interest probably dated back to Billings' medical school days, when he was required to write a thesis on epilepsy and had great difficulty in finding what had been written on the topic. It is clear that he was fully aware of the difficult problem of access to the medical literature from the time of his medical school days. At the time medical librarians throughout the world had not come to a consensus as to how to create indexes of their collections. Billings was the first to decide that his new library should be indexed alphabetically by both authors and subjects in a single list. To create this index for his growing library was to be a mammoth undertaking, which Billings undertook enthusiastically. The first volume was published in 1880 and referenced all the holdings in the library from A to Berlinski. Each year for the next 15 years one additional volume was published, so that finally by 1895 there were 16 large volumes, averaging more than 1,000 pages per volume, indexing all the holdings of the Surgeon General's Library. In preparation for the first volume it immediately became obvious to Billings that such an index could never be complete and up to date. He began to recognize it would take years to build a complete index and by the time the series was completed, it would be greatly out of date for new publications. Therefore, he decided to create in addition to his Index-Catalog an index that would be published monthly and include all new publications. He and his colleague, Robert Fletcher, brought

Figure 2. The National Library of Medicine in Bethesda, Maryland (author's photograph).



this idea to fruition in the form of the *Index Medicus*.³ The first volume was published in 1879 and actually preceded the first volume of his Index-Catalog for the library. These contributions by Billings—the development of the library, which eventually would become the National Library of Medicine; the Index-Catalog, which referenced each item in the library; and the *Index Medicus*, which kept the catalog up to date month by month and eventually became Med-Line—were perhaps among the greatest contributions of the 19th century to the infrastructure of science in general and to medicine specifically. In the early 1870s, as Billings was starting to conceive of his Index, it became obvious to him that the library should be available to more than just military personnel, and civilians were given access. This was clearly an important landmark on the way to creating a national medical library.

These contributions by Billings that had to do with the storage and retrieval of medical literature brought him great acclaim. This culminated in his invitation to give a general address to the Seventh International Medical Congress in London in 1881 (Fig. 3). He was the first American ever to be so honored. Others who were invited to give general addresses to the Seventh Congress included Virchow of Berlin, Volkmann of Halle, Pasteur of Paris, and Huxley of London. When Billings arrived in London for the week-long meeting, he was treated as a hero and hosted at many luncheons and dinners. On Aug. 3, 1881, 2 days before his address, he was hosted at a luncheon by Sir James Paget in his home in London. The guest list included the Prince of Wales, Dr. Bernhard von Langenbeck, and Sir Charles Darwin. His address was entitled “Our Medical Literature” and was 90 minutes long.⁸ It was delivered at St. James’ Hall on Piccadilly Street to an audience of approximately 900. Billings at the time was 43 years old. The address was

subsequently published in the *Boston Medical and Surgical Journal*, the forerunner of the *New England Journal of Medicine*. The lecture, as the name suggests, was on the medical literature and included many statistics that probably only Billings could have known from his indexing work. He suggested that the current physician did not need to know multiple languages or read the classics in their native language. He thought anything of value from the ancient literature had been reproduced in modern textbooks and “much of the larger part of all of our literature which has any practical value belongs to the present century, and indeed, will be found in the publications of the last 20 years.”⁸ The lecture was in large part based on his work on the Index-Catalog and *Index Medicus* and focused on the collection and storage of the medical and bioscientific literature and on its retrieval. He stressed that the information in these holdings represented the intellectual infrastructure on which modern medicine was constructed. The address was received with great acclaim. Europeans were astounded that an American who had received no training or education abroad could have made such a remarkable contribution. In a letter to his wife Billings wrote: “My address was a great success. The audience actually rose at me when it was done and shouted and cheered until they were hoarse.”³ This lecture elevated John Shaw Billings to one of the most admired American men of science in Europe.

PLANNING AND CONSTRUCTION OF THE JOHNS HOPKINS HOSPITAL

At the same time that Billings was doing his epic work on building and indexing the library of the Office of the Surgeon General, he was also becoming one of the experts in the country on hospitals and their construction. This re-



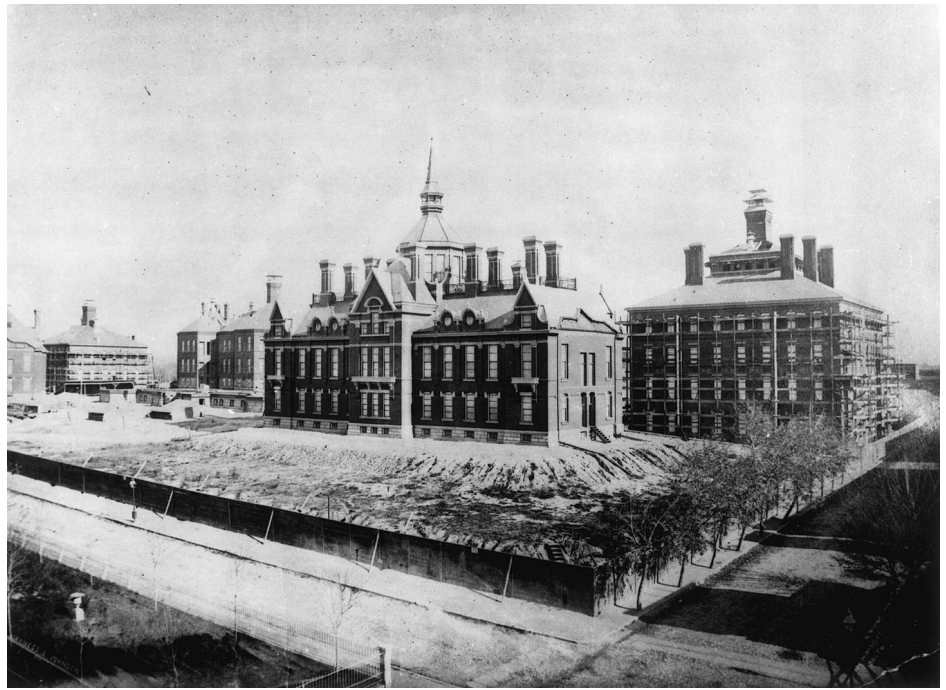
Figure 3. John Shaw Billings in his middle 40s. At this time he was in the midst of collecting and indexing books for the library of the Surgeon General and overseeing the construction of the Johns Hopkins Hospital. (Reproduced with permission of the Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions.)

sulted primarily from two tasks that he undertook for the Army. For the first 5 years after the end of the Civil War, Billings worked on disbanding the surgeons who had been recruited for the war and visiting and dismantling the dozens of military hospitals. In addition, in 1869 he was asked to examine the Marine Hospital Service, which consisted of 27 hospitals located throughout the country for sick and injured merchant seamen.^{6,7} There were many criticisms of the Marine Hospital Service, and Billings was asked to visit all of them and to make recommendations and suggestions for improvement. From these experiences Billings published two monographs from the Surgeon General's Office. The first, published in 1870, was entitled "A Report on Barracks and Hospitals." It emphasized the ventilation and heating of hospitals but also encompassed virtually all aspects of hospital construction. This monograph (called "Circular No. 4") promoted the pavilion principle of hospital construction, citing primarily the experience that had accumulated in France. The second publication, in 1875 ("Circular No. 8"), was entitled "Report of the Hygiene of the United States Army." This circular included more advanced thinking on the subject of hospital design and also touched on the maintenance of health in the U.S. Army.³

By this time the Billings family had become firmly en-

trenched in Washington life and in 1873 they purchased a home in Georgetown on N Street. Apparently the administrative positions he had been offered in the Office of the Surgeon General were more attractive than the prospects of civilian life and a private practice. About this same time, Mr. Johns Hopkins, a wealthy merchant, banker, and railroad developer from Baltimore died. He had made provisions in his will to leave money for both a hospital and a university. Although not clearly specified, it was assumed that a medical school would also be founded under the auspices of the money left to the university. After Hopkins' death in 1873, Billings, because of his growing national reputation as an expert on hospitals, was invited to meet with the Building Committee of the Board of Trustees of the Johns Hopkins Hospital and began a relationship that was to last a decade and a half, spanning the planning and building of the Johns Hopkins Hospital.³ After meeting with Billings, the Building Committee decided to write five hospital experts throughout the country and ask them to submit plans and advice on how to build the hospital. The five consultants were Dr. John Shaw Billings, Mr. Norton Folsom of the Massachusetts General Hospital in Boston, Mr. Joseph Jones of New Orleans, Mr. Casper Morris of Philadelphia, and Mr. Steven Smith of New York. All five had been involved in either planning or building a hospital or an addition to a hospital in their cities. The committee letter requesting a plan was mailed on March 6, 1874. John Shaw Billings submitted his plan on April 24, 1874, less than 2 months later. Billings not only presented an architectural plan for the hospital, but also provided much of the philosophy and culture that was to be accepted as part of the institution's fabric. He stated the plan of the hospital "must depend on the extent to and the manner in which it is to be used as an instrument of medical education and on the more or less intimate connection which it is to have with the medical school."³ He went on to say that even though the hospital's chief aim was to take care of the sick and injured, it also should "promote discoveries in the science and the art of medicine."³ He also emphasized that physicians should not only be educated to take care of sick patients, but also should be stimulated to think independently and to be investigators. Thus, Billings submitted not only plans and a philosophy for a hospital but also laid the groundwork for establishing the goals of the medical school. Billings' plan for the new hospital, using the pavilion system, was accepted. The facility's design included several widely separated pavilions that would be connected by long corridors. There would also be an administration building, a dispensary, and a surgical amphitheater. There would be charity wards and also pavilions for paying patients. It was well recognized at that time that infections and diseases were frequently caught or spread in hospitals. The germ theory was still evolving, and it was not clear whether bad or impure air, germs, or both played a role in the spread of disease in hospitals. The long corridors were included to

Figure 4. The Johns Hopkins Hospital under construction. It took 11 years to complete. (Reproduced with permission of the Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions.)



help prevent this spread. Ventilation was also thought to be very important.

The other four individuals submitted plans that were similar, but Billings was much more emphatic about making the hospital an integral part of the medical school, expressly stating the importance of building and equipping the hospital for teaching and investigation, as well as for taking care of the ill. In July 1876 Billings was appointed Medical Advisor to the Building Committee and embarked on a 13-year assignment culminating in the opening of the hospital in 1889.

After his appointment as the Medical Advisor, the Trustees of the Johns Hopkins Hospital sent Billings to Europe for 3 months to visit hospitals and study hospital design. Billings visited the hospitals in 20 different European cities. In his final report to the Board, he concluded: "It cannot be said that the general principles of hospital construction are as yet settled on any scientific basis . . . nearly as many opinions as persons . . ." ³ He went on to state that European hospital experts were "unbewildered by the slightest experience." ³ Fortunately on that trip he had a chance meeting with Dr. William H. Welch in Leipzig, Germany. Welch was a young aspiring pathologist from New York working in Ludwig's research laboratory. Billings visited Welch in the laboratory and that evening they met at Auerbach's Kellar for a social evening of beer drinking and discussion. Welch was to become Billings' choice for the first medical appointment to the Johns Hopkins Hospital, as the Chief of Pathology. Welch subsequently would become the first dean when the medical school opened 4 years later in 1893.

Billings submitted his final plan for a pavilion-like hospital in February 1878 and ground was finally broken in June of that year. ⁹ Billings, the planner, and John Niernsee,

the architect, worked together closely on the project. Construction proceeded slowly because of fiscal constraints and the hospital did not open for 11 years (Fig. 4). Because of his experience with hospitals in the Army, Billings was an expert on heating and ventilation, and these systems for the new hospital were considered at the time the most modern in the world. His work on planning and overseeing construction of the Johns Hopkins Hospital was to bring him great fame, even though he certainly did not originate the concept of the pavilion hospital, which came from France and Great Britain much earlier. Also, teaching hospitals were well known in Europe and were present in the United States in Boston, Philadelphia, Cincinnati, and elsewhere before the Johns Hopkins Hospital. However, Billings synthesized from his experiences in this country and his travels in Europe concepts for the most up-to-date physical structure, built to incorporate teaching and investigation as well as clinical care, and did so at a time when interest in elevating the care of sick patients and improving medical education was becoming a focus in this country.

The first president of the Johns Hopkins University, established in 1876, was Daniel Coit Gilman. ⁹ After the death of Johns Hopkins, the trustees for the new university recruited Gilman to Baltimore in 1875 from his position as president of the University of California. Gilman's background was principally at Yale, where he received his degree and served as a faculty member and administrator until 1872, when he accepted the presidency of the University of California. Gilman and Billings chose the first staff and faculty of the Johns Hopkins Hospital. As mentioned earlier, Billings met Welch for the first time in 1876 in Leipzig during his tour of European hospitals. Billings was very impressed with Welch and Welch's ready acceptance



Figure 5. The Johns Hopkins Hospital on completion in 1889. Photograph was taken looking southeast. (Reproduced with permission of the Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions.)

of the German university system of laboratory research. Billings told Gilman on his return from Europe that Welch should be recruited to Hopkins. However, this recruitment was not finalized until 1884. At the time Welch was at Bellevue Hospital in New York and despite many obstacles was beginning to perform laboratory research. Before Welch's final appointment was made in 1884, Billings visited him at Bellevue to observe him working in his laboratory and delivering a lecture. He remained impressed, and Gilman made the offer. William Osler, the first Chief of Medicine, was also jointly recruited by Billings and Gilman. An insight into Billings' personality and management style is given by Osler's recollection of the visit of Billings to Osler in Philadelphia in 1888. Osler recalled: "Early in the Spring of 1888, he came to my rooms, Walnut Street, Philadelphia. We had heard about the Johns Hopkins Hospital, and knowing that he was virtually in charge, it at once flashed across my mind that he had come in connection with it. Without sitting down, he asked me abruptly, 'Will you take charge of the Medical Department of the Johns Hopkins Hospital?' Without a moment's hesitation I answered 'Yes.' 'See Welch about the details: we are to open very soon. I am very busy today. Good morning.'"³ Osler recalled that Billings had been in his room for not more than 2 minutes. Subsequently it was Welch and Osler who recommended the next two faculty members at the Johns Hopkins Hospital. Welch recommended William Stewart Halsted for Chief of Surgery and Osler recommended Howard A. Kelly for Chief of Gynecology.

The Johns Hopkins Hospital opened on May 7, 1889, almost exactly 11 years after ground had been broken (Fig. 5). It consisted of 17 buildings on 14.5 acres (Fig. 6). Billings gave an address at the hospital's opening, stressing

that hospitals should endorse teaching and research because that ultimately benefited not only students and teachers, but also the patient. He also emphasized that the hospital should eventually be part of the medical school and university, a concept not universally held at that time. Billings and Gilman, although in agreement over most issues, eventually came into conflict concerning the requirements for admission to the medical school, which was to open in 1893. Billings was interested not only in hospital design but also in medical education within the hospital and university. Most medical schools at that time were of 2 or 3 years' duration, and Billings, as well as Gilman, felt that medical school should be 4 years. Billings also felt very strongly that a college liberal arts degree should be a requirement for entering medical school. Gilman, principally because of his background at Yale, felt that rather than a 4-year baccalaureate degree, perhaps a 3-year preparatory scientific course would be preferable. Gilman introduced a 3-year preliminary medical course at the Johns Hopkins University in 1878, well before either the hospital or the medical school was open. The course was not successful. Billings wrote and spoke publicly that the Hopkins Medical School should be "a model of its kind"⁹ for the rest of the country by insisting on a baccalaureate degree. John Warren, the editor of the *Boston Medical and Surgical Journal*, asked Billings to write an editorial for the journal on the topic of whether a 4-year baccalaureate degree requirement such as he proposed was preferable to the 3-year course proposed by Gilman. Billings declined to write such an editorial but stated in his return letter that Gilman "doesn't think it especially necessary that a physician should possess the culture which is presumed to belong to an AB or BS in the Hopkins University. In this opinion he is supported by



Figure 6. The Johns Hopkins Hospital in 1889, taken from behind the hospital looking north and west. One can see the pavilion construction of the hospital. (Reproduced with permission of the Alan Mason Chesney Medical Archives of the Johns Hopkins Medical Institutions.)

President Elliott of Harvard!”³ Amazingly, this argument reached the national lay press, and an editorial in *The New York Times* actually supported Billings. By the time the medical school opened in 1893, a college degree was indeed a requirement for admission. Thus, as well as playing a major role in the planning, design, and building of the Johns Hopkins Hospital, Billings also helped establish the philosophy and culture that became the fabric of not only the Johns Hopkins Hospital but also the Johns Hopkins University School of Medicine. In addition, he played a key role in recruiting some of the early faculty. Subsequently, as a nationally prominent expert on hospital planning and construction, he was to play a major role as a consultant in the building of the Peter Bent Brigham, Presbyterian, and Roosevelt Hospitals, as well as many others.

THE AMERICAN SURGICAL ASSOCIATION

At this point it might be well to emphasize Billings’ activities in the American Surgical Association. He was elected to membership in 1882, 1 year after his brilliant address at the Seventh International Medical Congress.¹⁰ He served on the Council of the American Surgical Association from 1884 through 1888. Many of the early meetings took place in Washington DC, and he hosted or was in charge of local arrangements for several of them. In the minutes of the sixth annual meeting held in Washington DC in 1885, the following statement is recorded: “Dr. Billings announced that an excursion had been arranged for the fellows to visit Johns Hopkins University and Hospital, in Baltimore on Wednesday afternoon. On motion the invitation was accepted.”¹⁰ Thus, Billings was by this time recognized as an

important member of the American Surgical Association, as well as the planner and builder of what would eventually become the most modern hospital of its time when it opened 4 years later. In 1894, at the request of the Program Committee, Billings gave a talk to the American Surgical Association entitled “Methods of Teaching Surgery.” Dr. Mark M. Ravitch, in his history of the American Surgical Association *A Century of Surgery*, described Billings’ address as “marvelously wise and witty” as well as a “brilliant talk on medical education.”¹¹ The talk was discussed by Dr. John Collins Warren of Boston as well as by Dr. W. W. Keen of Philadelphia, among others. Billings’ talk contained the suggestion that an operative course for teaching surgery by the use of animals might be appropriate. Halsted initiated the first such course in this country at the Johns Hopkins School of Medicine 1 year later in 1895.

Billings, in addition to his great skills as a library builder and indexer, a hospital designer, and a medical educator, had been considered earlier in his career an outstanding surgeon. Fielding H. Garrison, in his 1915 biography of Billings, stated: “Billings was one of the ablest American operators of his time . . . constantly in request as an adviser or consultant in difficult cases . . . all the major amputations and excisions, trephining and operations for gunshot wounds of the head and pelvis . . . He was the first surgeon in the war to attempt the unusual operation of excision of the ankle joint . . .”⁴ Subsequently Billings was elevated to an honorary member of the American Surgical Association.

UNIVERSITY OF PENNSYLVANIA

By 1895 Billings’ pioneering work at Hopkins had been completed. In addition, the 16th and final volume of the first

series of the Index-Catalog was to be issued that year. Billings' work in collecting, storing, and developing a retrieval system for the greatest collection of bioscientific information in the world had been completed. It was time to move on. In 1889 Provost William Pepper of the University of Pennsylvania wrote to Billings, offering him the Directorship of a Department of Hygiene at the University of Pennsylvania and the position of Director of the University Hospital and requested Billings to plan a building for the new Department of Hygiene.³ Pepper felt that Billings could stay in Washington DC until 1892, when he would be required under the terms of the arrangement to move to Philadelphia. In the interim he was to spend 1 day a week in Philadelphia. Billings accepted the offer. The building, which he planned to house the Hygiene Institute, was opened in 1892. However, Billings did not actually move to Philadelphia until 1895, when he officially resigned from the Army. He and his wife moved into a home in Philadelphia on Chestnut Street.

Billings had been persuaded to come to Philadelphia by an individual whom he had known for 30 years, Dr. Silas Weir Mitchell. Dr. Mitchell was one of Philadelphia's most prominent physicians and citizens and a trustee of the University of Pennsylvania. During the Civil War in 1862, Mitchell's younger brother Edward, a medical cadet, fell ill with diphtheria while in Washington DC. As it turned out, Billings cared for him at the Douglas Hospital.³ The illness eventually proved fatal, but Dr. Mitchell was so impressed and touched by the compassionate and meticulous care delivered by Billings that they were to develop a friendship that lasted until Billings died in 1913. When Billings eventually arrived in Philadelphia in 1895, he became the Director of the Institute of Hygiene and delivered a series of lectures on public health. This was a topic, however, that interested few, and few students attended. The curriculum included vital statistics and epidemiology, new fields that were of little interest to students of that era. Students at that time were interested in individual health care, not preventative medicine or the health of the population at large. Before coming to Philadelphia, Pepper had asked Billings to design a second building for clinical research, as well as the Institute of Hygiene. This building, called the Pepper Clinical Laboratory, opened in 1895 for training investigators for clinical research.

To commemorate Billings' retirement from the Army and his remarkable contributions to the storage and retrieval of the bioscientific literature, as well as his contributions to hospital design and construction and medical education, a testimonial dinner was organized by Dr. Mitchell and Dr. William Osler at the Bellevue Hotel in Philadelphia on Nov. 30, 1895. Because of the limited income received by a military officer, Billings was not financially well off, and Mitchell and Osler raised money from 162 American physicians and 87 physicians from the United Kingdom and presented Billings a check for \$10,000 at the testimonial.³ In addition, a magnificent portrait was painted by Cecelia

Beaux, which now hangs in the National Library of Medicine. An excellent reproduction also hangs in the Johns Hopkins Hospital. What was not known at the time of his testimonial dinner was that he had already resigned from his positions at the University of Pennsylvania, after residing only 8 months in Philadelphia, and was about to leave for New York City for a new challenge. Interestingly, during the prior 6 years he had served as Director of the Hospital of the University of Pennsylvania and most of this time resided in Washington DC.

FINAL CHALLENGE: NEW YORK CITY

The new challenge that Billings undertook was to be the first Director of the New York Public Library and to design and oversee construction of a new facility. The New York Public Library was founded in 1895 by the merging of the Astor Library, a reference library for scholars, the Lenox Library, a collection of great and rare books, and the Tilden Foundation Library.³ Samuel James Tilden was a New York politician and railroad lawyer who left his inheritance to "establish and maintain a free library and reading room in the City of New York."³ An agreement of consolidation was signed on May 23, 1895, and the three entities eventually merged on Jan. 15, 1896. Billings had been recruited for the position of director by Mr. Cadwalader, a wealthy New Yorker and brother-in-law of Dr. Mitchell.

Billings moved to New York in September 1896 to undertake the task of combining the three book collections, acquiring new volumes, cataloging the material, and planning and overseeing the building of a new facility. There were few if any other individuals in the United States with the administrative skills and the background in collecting, storing, and cataloging books and periodicals who could undertake this task. A site was searched for and eventually found at the corner of Fifth Avenue and 42d Street, where the Murray Hill Distributing Reservoir stood. An architectural firm was sought by the Board of Trustees, with significant input from Billings. Billings set broad outlines for the design of the new building and played a major role in picking the firm of Carrere and Hastings. Billings instructed the architects that he did not particularly care what the library looked like but wanted it to be absolutely functional. Billings suggested outlines and drew pictures in pencil to be used as guides by the architects. The building on the outside was primarily the work of the architects, but the design inside was in large part by Billings. The cornerstone for the new building was laid on Nov. 10, 1902, but the building was not occupied until May 23, 1911. The building cost a total of \$9 million dollars, approximately three times the original estimate (Fig. 7).

Billings' role in the building of the New York Public Library was similar to his role at the Johns Hopkins Hospital in that he planned and outlined the project but relied on an architect for the actual plans. Billings worked closely with Carrere and Hastings during the construction phase.

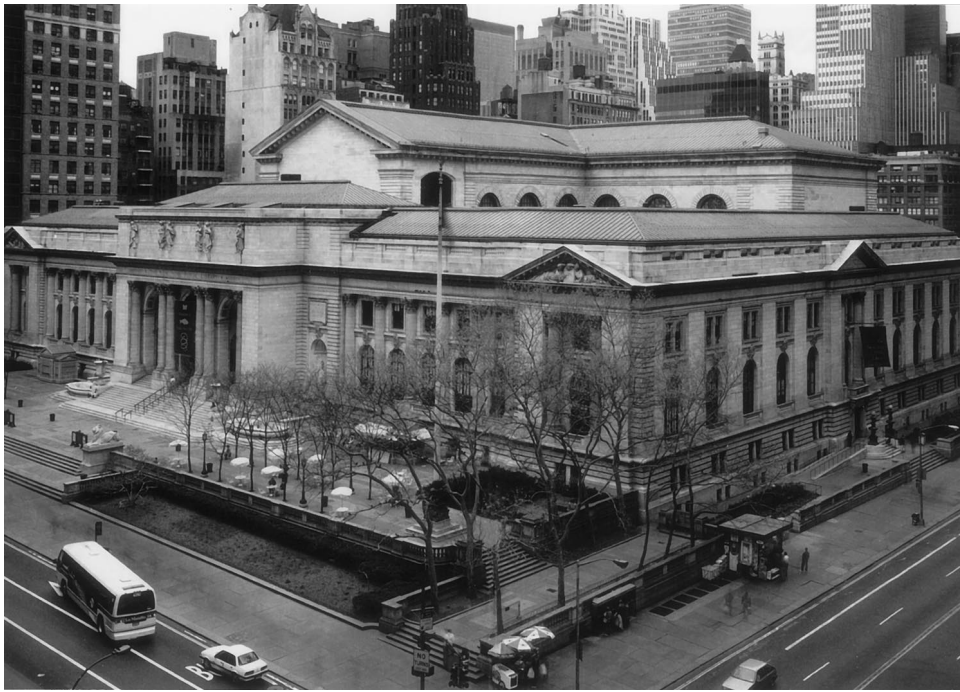


Figure 7. The New York Public Library on Fifth Avenue between 40th and 42d Streets (New York Public Library Manuscripts and Archives Division).

The building was architecturally and functionally a great success. It remains today one of New York City's most magnificent buildings and one of the country's most beautiful and functional libraries.

Billings met Andrew Carnegie at a dinner in New York City in 1892.³ Billings became a close friend of Carnegie's, visited him at his castle in Scotland on several occasions, and became perhaps his most valued consultant. Clearly at the request and prompting of Billings, Carnegie agreed in a letter written to Billings on March 12, 1901 to donate \$5.2 million for 65 branch libraries to be constructed in New York City for the New York Public Library. They were to be built at the rate of approximately 10 per year. When Billings died in 1913, 37 of the branches had been completed.

Billings was involved with Carnegie in many of his philanthropic ventures and played a major role in the founding and overseeing of the Carnegie Institution of Washington. Carnegie had wanted to establish a national university in Washington, and Gilman and Billings were two of his main consultants on this project. Both of them played a key role in convincing Carnegie that what was needed was not another university, but an independent entity to promulgate and fund independent research. The Institute was incorporated in 1902 and in 1904 received a grant of \$10 million from Carnegie. Billings, one of the original trustees, later became its director and remained so for the rest of his life. By 1910 the institute was granting more than \$5 million a year for independent research. By the time of his death Carnegie had given a total of \$333,299,460 in philanthropic efforts. Billings, as a consultant, influenced many of the projects.

Billings entered the New York Hospital on March 3,

1913, to be operated on by Dr. Francis Edgerton and Dr. John Rogers.³ He had undergone surgery several times previously. Between 1890 and 1892 he had been operated on by Dr. William Stewart Halsted on several occasions to remove benign lip lesions, presumably from his avid cigar smoking. In 1900 he had gallstones removed at the Roosevelt Hospital, and then 6 years later he underwent a cholecystectomy at the Presbyterian Hospital. In 1908 he was operated on again at the Presbyterian Hospital, possibly to remove a bladder stone. His last operation was at the New York Hospital, also for a bladder stone. Initially he apparently tolerated the operation well but subsequently he developed pneumonia and died on March 11, 1913, 1 month short of his 75th birthday (Fig. 8). His funeral took place at St. John's Church in Georgetown, March 14, 1913, some 51 years after he had been married there. He was buried in Arlington National Cemetery. Dr. Halsted was an honorary pallbearer.

ORDER OUT OF CHAOS

Billings was clearly one of the most productive and influential men of science and education of the 19th and early 20th centuries. His accomplishments and achievements in the minds of some elevate him to the rank of genius. In addition to his numerous successes described above, Billings was involved in many other productive projects. Near the end of the Civil War he became interested in collecting numbers and data for analysis and was appointed Medical Statistician of the Army of the Potomac. This effectively ended his days of caring for individual patients and moved him into the area of public health. In applying this new field of statistics to health issues, he made



Figure 8. John Shaw Billings several weeks before he died at age 74 years. (Reproduced with permission of the Alan Mason Chesney Medical Archives of The Johns Hopkins Medical Institutions.)

many important contributions, published many papers, and in 1880 was elected president of the American Public Health Association.³ His interest in statistics resulted in his playing an important role in the federal census of 1880 and 1890. While working on the 1880 census, Billings suggested to Herman Hollerith, who was also working on the census, that there was a need for an electrical mechanical tabulating machine for dealing with statistics, using cards with holes or slots. Hollerith, who credited Billings with the idea, subsequently developed such a machine and patented it. It was first used in Baltimore in 1887. It subsequently was manufactured and used throughout the United States and Europe. Hollerith sold his Tabulating Machine Company in 1911 and became a rich man. After other mergers, his company became an important part of a large corporation that came to be known as IBM.³

The motivations that led to Billings' successes, as with many great men, are not entirely clear. He had many of the stereotypes attributed to the surgical personality. He was precise. He was an excellent problem solver and an extremely hard worker. He had a commanding presence. He was 6 feet tall and weighed more than 200 pounds. However, he did not have the personality or presence that attracted attention the minute he entered a room, or stimulated great numbers to follow in his path. Although he was witty and collegial with his close friends, to most he presented a fairly solemn and serious facade. His first biographer,

Fielding H. Garrison, described Billings as "absolutely firm, independent, and self reliant, the temperament of the great organizer, administrator and man of affairs . . . absolutely honest and sincere . . . nothing small or mean about him . . ."⁴ In a letter to his wife dated July 9, 1863, from a field hospital near Gettysburg, Billings wrote: "The days creep by and I am still trying to produce order out of chaos, and to get my wounded patients into something like a state of comfort."¹² This statement, "creating order out of chaos," perhaps better than any other phrase describes Billings' career. It was used as a title by his most recent biographer, Carlton B. Chapman, in a beautifully written and exciting biography entitled *Order out of Chaos: John Shaw Billings and America's Coming of Age*.³ Whether he was dealing with how to design facilities to manage large numbers of sick patients or how to collect, store, and retrieve books, Billings spent his life trying to create order out of chaos. Chapman described Billings as such: "did great things in obscurity by moving resolutely toward drawing order out of chaos in the bioscientific records and more specifically in promoting knowledge and accumulating data concerning the health of millions."³ His efforts did not go unnoticed. He received honorary degrees from both Oxford and Edinburgh and was inducted into the National Academy of Science (along with Alexander Graham Bell in 1883). During his career he turned down many attractive career opportunities, including the editorship of the *Journal of the American Medical Association*. He was a founding member of the Cosmos Club and served as its president.

One of Billings' most remarkable characteristics was his prodigious ability to work, perhaps part of his surgical personality. He was clearly a workaholic generations before that term was invented. In all of his jobs throughout his life, he worked long days only to come home at night and work for many hours at home. His ability to work and his appreciation of the fruits of such efforts are vividly demonstrated in his following statement: "There is nothing really difficult if you only begin—some people contemplate a task until it looms so big, it seems impossible, but I just begin and it gets done somehow. There would be no coral islands if the first bug sat down and began to wonder how the job was to be done."⁷ While commenting on Billings' motivation to produce great things by hard work, the editor of *The Nation* wrote in 1881, "What could induce any man to spend years of labor in getting together and printing tens of thousands of titles—among the chief, no doubt, is the desire to be of public service—a feeling very strong in all Americans, except perhaps politicians."³

There are other lessons to be learned from Billings' successes, but also perhaps warnings to be heeded from his devotion to his career. He had a successful and long marriage to his wife Katy. They had one son and four daughters. Ostensibly they had a happy and secure family life. However, a letter from his son, John Sedgewick Billings, to his fiancée in 1896 suggests that the family life might not have been perceived by all of his children as ideal. The letter

included the following statements: "Their wives and children and friends are minor considerations . . . I would not lead my father's life for twice his name and fame . . . I have always hated my father's life . . . for what it deprived him of."³ In a later example, Billings did not attend his mother's funeral in 1898 because it conflicted with one of his trips.

An obituary written in the *Transactions of the Colonial Society of Massachusetts* very concisely summarizes his life: "John Shaw Billings . . . Director of the New York Public Library: One of that large class of men who do great things in obscurity, and who are never so sorely missed as when they die. Vigorous and precise, his energies were directed by a rare skill, and were sustained by a heroic perseverance."³

Thus, the Johns Hopkins Hospital benefited in its early days from the efforts of two great surgeons. William Stewart Halsted played a major role in establishing the Johns Hopkins Hospital as a major force in world surgery by helping to usher in the modern era of surgery. John Shaw Billings played an earlier and perhaps more basic role by planning the Johns Hopkins Hospital and overseeing its construction. He also contributed substantially to the discussions that led to education and research becoming such an important part of the culture not only of the hospital, but also subsequently of the medical school. In addition, his contributions to the collection, storage, and retrieval of medical information provided an important component of the infrastructure that was used to produce the marvelous advances of the 20th century. We have little evidence of communication between Halsted and Billings, but they were colleagues and friends. Halsted was one of Billings' honorary pallbearers at Billings' funeral. In addition, Halsted paid tribute to Billings at a meeting of the Johns Hopkins Hospital Historical Club in May 1913, after Billings' death. He recalled their first dinner meeting in 1887, so they had known each other for 26 years. Halsted's remarks, subsequently published, noted that "Dr. Billings was too great a man to be fully appreciated in this time."¹³ Perhaps he should have said "in any time." Tributes paid to Halsted and

Billings at Hopkins included a 1931 building housing the surgical services at the Johns Hopkins Hospital that was named in honor of William Stewart Halsted, and the original domed administration building of the hospital, built in 1889, that was named the John Shaw Billings Building in 1976 (it was placed on the National Register of Historic Buildings in 1975). A copy of the magnificent Cecelia Beaux portrait hangs in the lobby of this building.

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